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NOTE ON *HYPERASPIDIUS FLAVOCEPHALUS* BLATCHLEY, WITH DESCRIPTION OF THE FEMALE (COLEOPTERA, COCCINELLIDAE)

BY M. Y. MARSHALL,

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In 1924 Dr. Blatchley described this species (Canad. Ent., 56:167) from a unique male specimen collected near Dunedin, Fla., on March 27, 1918. Up to the present time, the female of the species has remained undescribed and, so far as I have been able to ascertain, no additional specimens of the species have been discovered.

For the past several years there has been in my cabinet a set of four specimens, two males and two females, of a species of *Hyperaspidius,* which were examined by the late H. C. Fall in 1937 and labelled by him "sp. nov". These were collected by Mr. C. A. Frost, at Berlin, Mass., on July 1, 1937. Since the males of this set appeared to correspond fairly well to Blatchley's description of *flavocephalus* and the females equally well to his short description of *Hyperaspis nigropennis,* which he collected at the same place and described on the same page, the specimens were referred to Mr. J. J. Davis, of Purdue University, for comparison with Blatchley's types, bearing in mind that several species of *Hyperaspidius* were originally described as *Hyperaspis.* Mr. Davis very kindly sent me the two unique types for study and Mr. Fall generously furnished me the balance of his material in the species, which consisted of 20 specimens, 6 males and 14 females, all taken in the same general locality, by "sweeping". Comparison with the type of *flavocephalus* shows that the Massachusetts specimens are undoubtedly that species; but comparison of the females with the type of *H. nigropennis* shows that the latter is a very different thing, a true *Hyperaspis.*

In addition to describing the female, I wish to record the extent of specific variation in the male and to make some slight corrections in Dr. Blatchley's description.

Description of female: Oblong oval, moderately convex, apices of elytra obtusely truncate. Elytra black, moderately shining, the head and thorax blackish piceus, slightly alutaceous, the labrum piceotestaceus. Front angles and narrow lateral margins of pronotum, narrow humeral margins of elytra, prothoracic and elytral epipleura, mesosternal epimera, antennae, palpi, tibiae and tarsi testaceus. Remainder of under surface blackish piceus, the femora and abdomen paler than the sterna. Head and thorax very finely and moderately densely punctured, the elytral punctures equally dense but much coarser. Entire upper surface, except the labrum, glabrous, the latter with numerous erect hairs. Under surface finely punctured, the metasternum more coarsely so, and sparsely pubescent with yellow hairs, the pubescence longer and sericeous on the abdomen. Length 2.6 mm. Width 1.8 mm.

Allotype, female, Berlin, Mass., VI-20-40, in collection of author. Parallotypes in collection of Mr. C. A. Frost and the Blatchley collection at Purdue University. Parallotypes collected at Berlin, Mass., VI-27-37, VII-1-37, VI-20-40 and VII-6-40; Wayland, Mass., VI-29-30; and Natick, Mass., VI-19-32 and VI-22-41.

Variation in the female: The length varies from 2.0 to 2.7 mm. The pale thoracic margin in the allotype and in the majority of the other females is narrow and not sharply defined from the disc. In some specimens it is wider and approaches a clear yellow in color, as in the male, and is sharply defined on its inner border. In some it is reduced to a small yellowish spot at the anterior thoracic angles, but in no specimen is it completely absent. The pale humeral spot in the allotype occupies about one-sixth of the elytral margin. In other specimens it extends backward for a variable distance, as an ill-defined piceotestaceus margin to the elytron, which in a few cases attains the suture at the elytral apex. In some specimens the humeral spot is very poorly defined and in some it is entirely wanting. No particular variation is noted on the under surface, except that the parts which are noted as testaceus in the allotype become more or less tinged with piceus in most of the specimens. The tips of the maxillary palpi are piceus in a few instances.

Variation in the male: Length from 1.8 to 2.5 mm. The chief variation noted in the males is in the extent of the piceus coloration of the prothoracic disc. In the unique type from Florida the central four-fifths or so of the basal margin is piceus, this area extending forward on the midline about one-fourth the distance to the apical thoracic margin, with the anterior border of the piceus area broadly emarginate. In the two original males from Massachusetts, this area extends at least three-quarters of the distance to the apical margin and the anterior border is narrowly and angularly emarginate. I was at first tempted to describe the Massachusetts specimens as a new subspecies; but the series of eight males now available shows that this is merely intraspecific variation. In some specimens the entire disc, with the exception of a very narrow anterior margin and broader lateral margins, is piceus and in these the occiput also becomes piceus. At the other end of the series is a specimen which is almost identical with the Floridan type. As the anterior border of the piceus area recedes in a caudal direction, two small, obliquely placed oval dots are uncovered, one each side of the centre of the disc, their posterior ends practically touching in the midline. It is these spots that produced the angular emargination mentioned above. On close examination of the type, these spots, which are not mentioned in the original description, are clearly discernable, though faint and afford strong evidence that the Floridan type and the Massachusetts specimens are one and the same species. The humeral spot or stripe varies to about the same extent as in the female, but is never entirely absent and is always of a clearer yellow than in that sex.

Comments on the original description., The basal margin of the thorax, in the type, is piceus and not "shining black", as stated in the description and the front and middle legs are testaceus, rather than "clear yellow" and are only slightly paler than the hind legs. The mesosternal epimeron *is* a clear yellow, which is not mentioned in the original description and forms a sharp contrast with the piceus black of the adjacent sternites. This, as well as the thoracic spots mentioned above, would not be noticed in the type unless specifically searched for, as this portion of the type specimen is somewhat obscured by glue. The parts described as clear yellow are definitely orange in color at the present time, which is probably due to the age of the specimen.

The species is evidently not rare locally, for a period of about two weeks, toward the end of June and will probably be found to inhabit the entire Atlantic seaboard, from New England to Florida. Further collecting in the Florida area may show that its separation into a northern and a southern subspecies would be justified.

I wish to express my thanks to both Mr. C. A. Frost and Mr. J. J. Davis for their kind assistance.

REMARKS ON SOME PACIFIC COAST SPECIES OF *TROPISTERNUS* (COLEOPTERA: HYDROPHILIDAE) *

BY HUGH B. LEECH,
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Thanks to the generosity of Dr. Armand d'Orchymont, Conservateur of the Royal Museum of Natural History in Brussels, I have recently obtained reprints of certain of his papers published during the occupation of that country by the Germans.

In one of them† he has placed *Tropisternus columbianus* Brown 1931 as a synonym of *T. californicus* (LeConte 1855), and has described as *T. caligans* d'Orch. the species construed as *californicus* by Brown. In addition he suggests that *Tropisternus californicus* Motschulsky 1859 is the same as *T. salsamentus* Fall 1901.

Careful readings of the original descriptions involved, and examination of verified examples of *californicus* (LeConte), *columbianus* Brown and *salsamentus* Fall lead me to somewhat different conclusions, as shown below.

Tropisternus (Pristoternus) californicus (LeConte)

Hydrophilus californicus LeConte 1855, Acad. Nat. Sci. Philadelphia, Proc. 7:367 (in part?)
Tropisternus californicus LeConte, Horn 1876, Amer. Ent. Soc., Trans. 5:252 (in part); Sharp 1883, Ent. Soc. London, Trans. 1883 (2):109 (in part).
Tropisternus (*Cyphostethus*) *californicus* LeConte, d'Orchymont 1922, Soc. Ent. Belgique, Ann. 62:17, 29 (in part).
Tropisternus (*Pristoternus*) *caligans* d'Orchymont 1944. Musée roy. Hist. nat. Belgique, Bul. 17 (41):3-4.

In March, 1940, I sent a male and a female of each of two species (*californicus, columbianus*) to Dr. P. J. Darlington of the Museum of Comparative Zoology at Cambridge, Mass. He compared them with LeConte's type of *californicus*, and reported as follows (letter of March 11, 1940): "The type of *californicus* agrees with your No. 2, in its relatively coarsely punctate elytral apices; type bears merely a gold disk (=California) for locality."

Writing of *californicus* in 1883 Sharp (p. 109-110) said, "The species is variable, and there may be more than one mixed under the name. In one form there is a well-marked development of coarse punctuation on the sides of the elytra towards the extremity while in other specimens this additional sculpture is quite absent; this latter form is usually of darker and less metallic colour." It appears to me that d'Orchymont has misread this, for he says (1941:3-4), "En commentant l'*Hydrophilus californicus* LECONTE, SHARP en distingua une forme plus obscure, moins métallique, présentant un développement bien marque, parmi la fine ponctuation foncière des côtés et de l'extrémité des élytres, de points additionnels plus gros. L'auteur croyait probable la confusion sous le même nom d'espèces distinctes. L'examen d'un matériel assez fourni en exemplaires à ponctuation des élytres double me permet d'affirmer qu'il en est bien ainsi et en conséquence je désigne la forme distinguée par Sharp, mais sans la nommer, du nom de *caligans*."

Sharp did not specify which form he thought to be the true *californicus*, but he said it was the finely punctuate form which was darker and less metallic.

T. californicus was described as from "San Francisco and San Diego." According to the specimens before me it is strictly a coastal species, occurring from near Ensenada, Lower California, northward at least to the Winchester Bay region of Oregon. LOWER CALIFORNIA, MEX.: 3, Seventeen miles south of Ensenada, June

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†See A. d'Orchymont 1941. "Le genre *Tropisternus* (Coleoptera, Hydrophilidae), 5e partie. Notes nouvelles et mise au point de la monographie de ce genre. Musée roy. Hist. nat. Belgique, Bul. 17 (41):1-7.

14, 1938, Michelbacher and Ross coll. CALIFORNIA: *San Diego Co.*:2, Vallecito Valley, Sept., 1925; 1, Coronado, April. *Los Angeles Co.*: 3, Santa Monica, July 3, 1924, Warwick Benedict coll. *San Luis Obispo Co.*: 1, Pismo Beach, March 8, 1937, E. S. Ross, H. B. Leech & M. Cazier coll. *Santa Clara Co.*: 3, Stanford University (=Palo Alto), March 16, 1915. *San Francisco Co.*: 6, Inglewood, April 16, 1909. *Alameda Co.*: 1, Lake Merritt, Oakland, April 11, 1909; 1, Mills College, October 6, 1936, H. B. Leech coll. *Contra Costa Co.*: 1, Sleepy Hollow, Orinda, May 3, 1938, H. B. Leech coll. *Sonoma Co.*: 3, Harris Pond, Santa Rosa, March 26, 1893, L. E. Ricksecker coll. *Mendocino Co.*: 2, Mendocino, August 3, 1940, J. R. Helfer coll. OREGON: *Douglas Co.*: Gardiner, June 27, 1936.

The type of *caligans* d'Orch. is from Carmel (Monterey Co.), Calif. Paratypes are from Carmel, Santa Barbara (Santa Barbara Co.), Redondo (Los Angeles Co.). Listed also is a male paratype from "New Mexico"; by the simple label this is probably an old specimen, and since all other examples are from the coast, it is surely mislabelled. I have an old specimen from the Luetgens' Collection, via the C. W. Leng Collection, which is said to be from "N[ew]. J[ersey].", and was identified by Luetgens as *glaber* (Hbst.).

T. californicus and *columbianus* may be separated as follows:

1. Pubescent area of metafemora very small, confined to the extreme base, barely or not reaching to tip of trochanters, outer margin concave (fig. 1). Elytra nearly uniformly punctate (except for the usual very coarse serial punctures), with at most a few scattered slightly larger punctures in apical quarter. Free part of metasternal keel, in profile, nearly straight, barely or not curving away from the abdomen. Median lobe of aedeagus (ventral view) projecting only slightly beyond the tip of the gonopore. A widely distributed species occurring from British Columbia to southern California and east to the Dakotas ..... *columbianus*

——Pubescent area of metafemora more extensive though still small, clearly reaching to tip of trochanters, outer margin nearly straight (fig 2). Elytra with dual punctation in apical quarter and to about middle near sides, the large punctures numerous, irregularly spaced, nearly obliterating the small primary punctation. Free part of metasternal keel (profile) curved, the tip furthest away from the abdomen. Median lobe of aedeagus projecting beyond the gonopore for a distance equal to 1/2 to 2/3 the length of gonopore. A coastal species known from northern Lower California to about mid-Oregon ..... *californicus*

Except for differences in width, which are not correlated with distribution, *californicus* shows little variation.

Tropisternus (P.) columbianus Brown

Tropisternus columbianus Brown 1931, Canad. Ent. 63 (5):117.
Tropisternus (Pristoternus) californicus LeConte, d'Orchymont (non LeConte) 1941, Musée roy. Hist, nat. Belgique, Bul. 17 (41):2.

The types of *columbianus* are from Malahat, Vancouver Island, B. C., except for one paratype labelled just Vancouver Island. Malahat is on a scenic drive just west of the main Victoria-Nanaimo highway, about 17 miles from Victoria.

Specimens before me are as follows. BRITISH COLUMBIA: *Vancouver Island*: 2, Cowichan Lake, July 6, 1937, Idyll coll.; 1, Courtenay, May 1, 1932, J. D. Gregson coll. *South-western mainland*: several specimens, Abbotsford, September 14, 1945, H. B. Leech coll.; 1, Lost Lagoon, Vancouver, June 11, 1931, H. B. Leech coll.; 1, Ruskin, September 14, 1945, H. B. Leech coll.; 4, Haney, March 22, 1930, H. B. Leech coll. WASHINGTON: *King Co.*: 1, Seattle, June 1, 1932 (?), Heinemann coll. OREGON: *Washington Co.*: 3, Dilley. *Yamhill Co.*: 2, McMinnville, April 6, 1936, K. Fender coll.; 8, April 8; 1, July 5. *Benton*

Co.: 2, Corvallis, July 20, 1925. *Jackson Co.*: 1, Rogue River, May 3, 1937, F. Lawrence coll. *Deschutes Co.*: 8, Deschutes River near Tumalo, August 22, 1939, Gray & Schuh coll. *County ?*: 3, Frenchglen, July 30, 1935. CALIFORNIA: *Mendocino Co.*: 1, Mendocino, August 3, 1940, J. R. Helfer coll. *Sonoma Co.*: 1, Harris Pond, Santa Rosa, March 26, 1893, L. E. Ricksecker coll. *Alameda Co.*: 2, Oakland, October 18, 1936, H. B. Leech coll. *Santa Clara Co.*: 1, Gilroy, July 16, 1942, Zamzow coll. *San Benito Co.*: 2, Mercy Springs, February 22, 1931, R. W. Wagner coll. *San Luis Obispo Co.*: 1, Pismo Beach, March 8, 1937, E. S. Ross, H. B. Leech & M. Cazier coll. *Los Angeles Co.*: 1, San Gabriel River at Whittier, May 9, 1944, E. Ewy coll. *San Diego Co.*: 1, San Diego, March 8, 1929. *Kern Co.*: 1, Tehachapi, May 1, 1937, H. B. Leech coll. *San Bernardino Co.*: 4, Yermo, April 28, 1937, H. B. Leech coll. *Inyo Co.*: 2, Lone Pine, May 26, 1937, C. D. Michener coll.; 4, June 10, 1937. *Shasta Co.*: 1, Manzanita Lake, Lassen National Park, 5,800 ft. elev., October 1, 1944, B. Malkin coll. Also one from Sand Pit Lake, Yosemite Nat'l Park, July 13, 1939, D. L. Tiemann coll. UTAH: *Cache Co.*: 1, Logan, March 21, 1930, G. F. Knowlton coll. *Salt Lake Co.*: Salt Lake City, April 18, 1935, G. F. Knowlton & W. L. Thomas coll. COLORADO: *Boulder Co.*: 5, St. Vrain Sloughs, 4,900 ft. elev., April 22, 1934, E. B. Andrews coll. *Fremont Co.*: 5, six mi. south of Hillside, August 25, 1941, H. C. Severin coll.; 1, ten mi. west of Cotopaxi, August 23, 1941, H. C. Severin coll. SOUTH DAKATA: *Lawrence Co.*: 1, five mi. south of Deadwood, June 22, 1940, H. C. Severin coll. *Pennington Co.*: 1, pond, Rapid City, September 7, 1940, G. B. Spawn. *Custer Co.*: 3, ten mi. north of Wind Cave, Black Hills, June 22, 1940, H. C. Severin coll.; 4, Wind Cave, September 6, 1940, G. B. Spawn coll. *Bennett Co.*: 1, Martin, September 15, 1931, H. C. Severin coll. *Brown Co.*: 2, Aberdeen, September 24, 1939, G. B. Spawn coll. *Roberts Co.*: 8, Big Stone Lake, September 13, 1939, H. C. Severin coll. *Charles Mix Co.*: 2, Wagner, June 14, 1940, H. C. Severin coll.

These localities make it certain that *columbianus* occurs also in Minnesota; for instance Big Stone Lake forms parts of the boundary between that state and South Dakota, and is close to North Dakota. In this territory it is likely to be confused with some of the eastern species, and with *sublaevis* (LeConte 1855).

From all eastern species which occur as far west as South Dakota, *columbianus* may be distinguished by the following combination of characters: (1) no free preapical spine on the last abdominal sternite, though there may be a small ridge with an apical tuft of hairs; (2) pubescent area at base of metafemora very small, barely or not reaching the tips of the trochanters, the line from there to the anterior margin of the femora appreciably concave (fig. 1); (3) free section of metasternal keel almost straight, not curving away from the abdomen; mesosternal section narrow, very slightly convex.

Tropisternus sublaevis and *columbianus* may be separated as follows:

1. Metafemora parallel-sided in basal two-thirds, flat, sparsely and moderately coarsely punctate, in large part testaceous. Mesosternal keel very finely punctate in both sexes. Posterior mesotarsal claw of male with the tooth about equidistant from tip to base (fig. 3). Larger species, less parallel-sided, color of elytra distinctly green ..... *sublaevis.*

——Metafemora not parallel-sided in basal two-thirds, the posterior margin gradually curved; metafemora distinctly inflated, more coarsely and numerously punctate, in large part piceous or black. Mesosternal keel finely punctate in the female, rather sparsely and moderately coarsely punctate in the male. Posterior mesotarsal claw of male with the tooth longer and more apical, so that the general appearance is more like the "pincers" of a crab (fig. 4). Smaller species, more parallel-sided, dorsal elytral color blacker with a slight bronze lustre ..... *columbianus.*

The wide-ranging *columbianus* shows, as is to be expected, variation in many characters. Examples from British Columbia and Washington average larger and broader; those from Colorado, Utah, South Dakota, and alpine California narrower, with more sparsely punctured mesosternal keel and metafemora. However, Dakota-like specimens occur also on the mid-California coast, and there seem not to be any subspecies involved.

Tropisternus (P.) salsamentus Fall

Tropisternus salsamentus Fall 1901, Calif. Acad. Sci., Occ. Papers 8:214; Blaisdell 1925, Pan-Pacific Ent. 1 (4):169.

Tropisternus (Pristoternus) salsamentus Fall. d'Orchymont 1922, Soc. Ent. Belgique, Ann. 62: 15, 26; d'Orchymont 1941, Musée roy. Hist. nat. Belgique, Bul. 17 (41):1-2.

?*Tropisternus californicus* Motschulsky (non LeConte 1855) 1859, Soc. Imp. Nat. Moscou, Bul. 32 (3):175. (According to d'Orchymont, loc. cit.)

The types of *salsamentus* were taken by Fenyes and Fall in April and July, "from a small salt lake just back of the ocean beach at Redondo [Los Angeles Co., Calif.]. This lake is much saltier than the ocean itself." Blaisdell has recorded it from Ensenada, Lower California; from San Diego, and from Redwood City on San Francisco Bay, Santa Clara Co., Calif. d'Orchymont adds Santa Barbara, Santa Barbara Co. I have before me the following examples: 2, Ensenada; 1, Coronado, San Diego Co.; 1, Santa Cruz, Santa Cruz Co., July 31, 1901 (det. H. C. Fall); 1, Los Angeles Co., July 20, 1924; and 48 from a salt water lagoon at Huntington Beach, Los Angeles Co. (about 20 miles south of

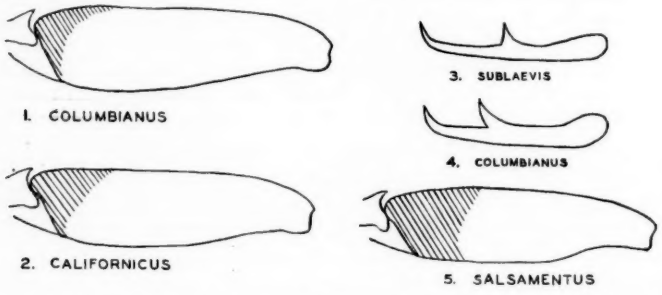

Fig. 1. Metafemur of *Tropisternus columbianus* Brown, to show extent of pubescent area at base. Fig. 2. Same, *T. californicus* (LeConte). Fig. 3. Posterior (inner) mesotarsal claw of male *T. sublaevis* (LeConte). Fig. 4. Same, *T. columbianus*. Fig. 5. Metafemur of *T. salsamentus* Fall. All drawings are semidiagrammatic.

the type locally), July 19, 1943, Geo. P. Mackenzie coll. Hatch has listed *salsamentus* from western Washington ("Preliminary list of the Coleoptera of Washington." Seattle, October 1939. Mimeographed), a surprising northward extension of known range.

T. californicus Motschulsky was described as from San Francisco. D'Orchymont concludes from the original description that it is the same as *salsamentus;* if true this is convenient, for Fall's name may be used to replace Motschulsky's homonym. D'Orchymont cities as evidence the following points mentioned in the description: the elongate form, the posteriorly dilated form of the pronotum, the posteriorly attenuated elytra, and above all, the greenish tint of the dorsum.

My own interpretation is that Motschulsky had two species in his type series, and neither of them was *salsamentus.* He says "La femelle est un peu plus large, plus arrondie et on voit sur les élytres quelques gros points bien marqués." This can apply only to the true *californicus* (LeConte). He further says, "Il y a toujours aux cuisses postérieures une tache apicale testacée. Le Mésosternum est plus étroit, sans impressions et chez le mâle sans ponctuation

antérieurement." Now the mesosternal keel of males of *salsamentus* is definitely punctate right to the anterior tip; and an apical testaceous spot on the metafemora does not describe *salsamentus,* for one of its notable characters is that the legs are entirely yellow or testaceous except for the piceous pubescent area at the base (fig. 5). It may be signifificant that some San Francisco examples of *californicus* (LeC.) before me are as narrow and elongate as *salsamentus,* have attenuated elytral apices, and a greenish dorsal sheen.

Tropisternus (Pristoternus) orvus* n. sp.

A dark green to black species, allied to and resembling *T.* (*P.*) *ellipticus* (LeConte 1855). Known from northern California, northwestern Oregon, and Washoe Co., Nevada.

Male. Length 10.0 mm., width 5.0 mm. Dorsal surface, except labrum and punctation of the head, pronotum, scutellum and elytra; labrum black. Basal segment of antenna yellow, 2 to 6 progressively darker brown, club black. Maxillary palpus yellow, apical third of ultimate segment piceous; labial palpus reddish brown like outer half of mandible. Undersurface black (pubescence yellowish), except: the inflexed margins of the pronotum and elytra, apices of all femora, all tarsal claws, outer (posterior) half of the protibiae, and a narrow area along the upper posterior margin of the pro- and metatibiae, all of which parts are reddish-yellow; and metasternal keel piceous.

Head finely punctate, except for the usual coarse serial punctures. *Pronotum* finely punctate; medio-lateral, setal-bearing, coarse punctures coalesced to form a single large pit; a few similar but smaller punctures present anteriorly, a little closer to the median line than to the sides, and there are several nonsetose impressions. *Elytra* more finely and sparsely punctate than the pronotum, except for three series of coarse punctures and indications of a line of strial punctures on each side of the outer one of these; humeral angles turned under, not visible from above. Elytral apices subtruncate. Tip of *sternal keel* reaching almost to hind margin of apparent 2nd sternite; mesosternal section of keel almost flat, the face rounded and without a sharp margin laterally, widest just behind middle where it is subequal to apical width of protibia; posterior half very finely punctate, anterior half moderately coarsely so. Metasternal section of keel canaliculate in median half, gradually narrowed to the pointed apex, sparsely punctate except at base. *Metafemora* flat, nearly parallel-sided in basal half, with some irregularly placed coarse punctures in the outer two-thirds; basal pubescent area not extending beyond apex of metatrochanters on posterior margin, but a little further on anterior. Metatibiae narrow, parallel-sided in outer two-thirds, subcylindrical. Median apical margin of apparent 5th sternite with a small tuft of hair, but no spine or embossment.

Female. Length 10.5 mm.; width 5.5 mm. Differs from the male as follows: there is a coppery reflection on the pronotum; the coarse, medio-lateral, systematic punctures, which are diagonally arranged, three on the right side, four on the left; the meso- and metafemora have fewer punctures; the mesosternal portion of the sternal keel has fewer coarse punctures anteriorly, but larger punctures over the rest, and is wider and less flat; the apical half of the metasternal portion of the keel is rufescent; the inner (posterior) claws of the meso- and metatarsi are not toothed.

Holotype. The male described above, Mendocino, Calif., 16.VIII.40. (J. R. Helfer); No. 5635 in the Canadian National Collection.

Allotype. Female. Same data, August 3.

Paratypes. CALIFORNIA: 39 topotypes, 18 ♂♂, 12 ♀♀, August 3; 3 ♀♀, August 11; 5 ♂♂, 1 ♀, August 16. Also 1 ♂, 1 ♀, Challenge, *Yuba*

*Name without derivational significance.

Co., 15.VII.28 [R. S. Wagner] 1 ♂, *Tuolumne Co.*, 25.VII.26 [received from Mr. J. W. Angell of New York.]. 1 ♂, Big Spring, *Shasta Co.*, 29.V.41 (C. Michener). 1 ♀, Manzanita Lake, Shasta Co., 6.VI.41 (C. D. Michener). 1 ♀, Carson Pass, 2.IX.33 (G. E. Bohart). 1 ♀, *Sonoma Co.*, 1.VI.38 (J. W. Tilden). OREGON: 1 ♂, 1 ♀, Dilley, [from the collection of the late C. W. Leng]. The paratypes vary in length from 9.5 to 11.0 mm. A few have coppery reflections all over the elytra.

The following specimens, all females, have also been studied: 2 from the Leng Collection, labelled "Cal." and collected by L. E. Ricksecker; 1 in the Yosemite National Park Collection, labelled "Black Spring, Yos. Valley, Calif., Elev. 4,000, 30.III.39 (D. L. Tiemann); 1 from the Leng Collection labelled "Franktown, Nevada."

Because of the greatly reduced series of medio-lateral systematic punctures on the pronotum (the allotype is the only specimen to have as many as four), *T. orvus* should be placed next to *ellipticus* (LeConte), which occurs in at least part of the same region. From *ellipticus* and all other nearctic species it may readily be separated by the following combination of characters: maxillary palpi short and stout, the pseudobasal segment barely or not reaching the eye, and subequal in length to the ultimate segment; elytra extremely finely punctate apically and subtruncate; elytral humeri turned under and not visible from above; metasternal portion of sternal keel straight (in profile), the mesosternal portion arcuate and not in the same plane; legs long, slender and almost entirely black.

Paratypes will be distributed to the following institutions and persons: The California Academy of Sciences, San Francisco; the U. S. National Museum, Washington; the Canadian National Collection, Ottawa; the British Museum, London; La Colección Nacional de Insectos Mexicanos, Instituto Politécnico, Mexico, D. F.; Drs. A. d'Orchymont, F. N. Young, M. H. Hatch; Messrs. K. F. Chamberlain, J. B. Wallis, H. P. Chandler, F. E. Winters.

The examples of *Tropisternus columbianus* Brown from South Dakota, and some of those from Colorado, were kindly submitted to me by Dr. H. C. Severin of the State College at Brookings, S. D.

THE GENUS *GIRSCHNERIA* TOWNSEND (DIPTERA, TACHINIDAE)*

By A. R. BROOKS,

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In 1885 von Ernst Girschner described a remarkable *Carcelia*-like fly from the Thuringian district of central Germany which was noteworthy in that it possessed a number of paired plumose hairs on the head. The facial hairs were the more noticeable as they originate not on the facialia or parafacialia as normal bristles, but apparently in the ptilinal groove between the two regions, two pairs being found here and three pairs on the anterior part of the front. Mik, who saw the only specimen of this fly believed the remarkable feathered bristles of the head to be of extraneous origin, but Townsend (1918), convinced that this was not the case (he did not see the fly), named it *Girschneria mirabilis* n. gen., n. sp. on the basis of Girschner's original description and illustrations. Unfortunately the only known specimen and holotype of *G. mirabilis* Tns. has been lost, so the exact nature of the plumose bristles has never been established.

*Contribution No. 2377, Division of Entomology, Science Service, Department of Agriculture, Ottawa.

The Canadian National Collection contains a series of eight specimens of *Leschnaultia* reared at Ottawa in 1908 from *Halisidota caryae* Harr. which help to throw some light on the true nature of plumose head bristles in parasitic flies. Each of the flies in this series has a number of long plumose bristles issuing from the ptilinal suture both on the front and on the face, some specimens also having similar bristles originating between the tarsal segments, around the

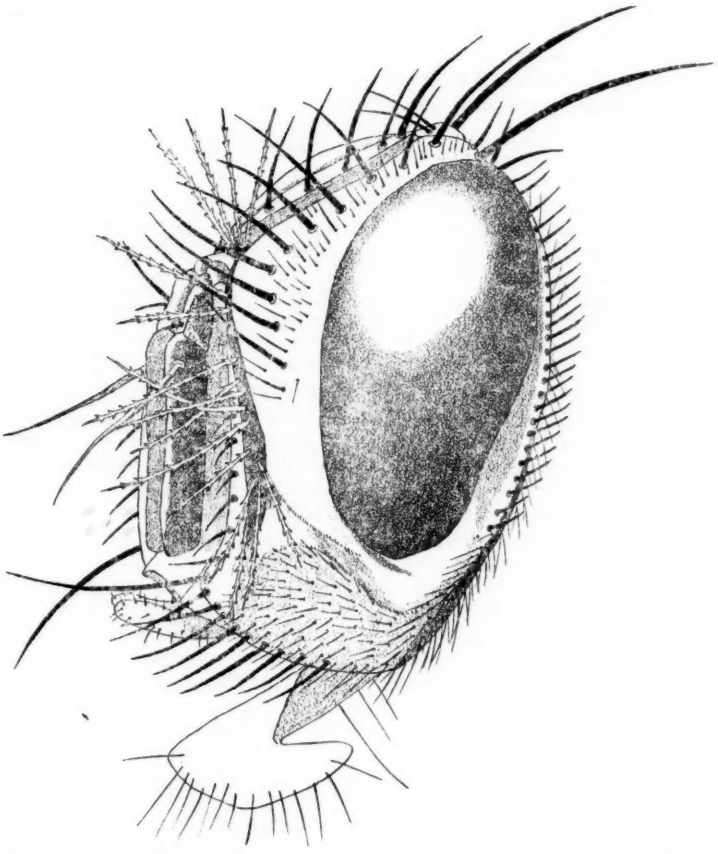

Figure 1. Head of *Leschnaultia* species, showing plumose bristles issuing from the ptilinal suture.

genital segments or piercing the wing membrane. These plumose bristles are identical with those making up the cocoon of the host, their position in the ptilinal suture and in various body membranes indicating that they had become stuck to these parts as the fly was emerging from the host cocoon, at which time the membranes are greatly expanded. While the bristles show a remarkable symmetry in their position, ranging from one or two on each side of the face to twenty or more, there can be no doubt as to their origin.

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NEW NEARCTIC CRANE-FLIES (TIPULIDAE, DIPTERA). PART XXV.

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The preceding instalment under this title was published in 1945 (Can. Ent., 77: 140-144). At this time I am including the description of five species of the genus *Tipula* from Washington, Oregon and California, collected by Messrs. T. H. G. Aitken, Mont A. Cazier, J. A. Macnab and A. L. Melander, to whom I am greatly indebted for the privilege of studying very extensive series of Tipulidae sent by them. Except where indicated to the contrary, the types of the novelties are preserved in my collection.

Tipula (Lunatipula) carunculata n. sp.

Belongs to the *impudica* group, allied to *diversa* and *lyrifera;* size relatively large (wing, male, 18 mm.); general coloration of thorax gray, the praescutum with four reddish brown stripes; legs brownish yellow, the outer tarsal segments blackened; wings infuscated, particularly in the apical and posterior fields; obliterative bands at cord and beyond stigma; male hypopygium with the median blade of tergite depressed, the canthi conspicuously toothed or provided with carunculae; inner dististyle with the outer basal lobe a narrow compressed-flattened blade, not twisted as in *lyrifera.*

Male. Length about 19 mm.; wing 18 mm.; antenna about 5.7 mm.

Frontal prolongation of head brownish yellow; nasus reduced to a blunt tubercle; palpi with basal segment obscure yellow, the succeeding segments slightly darker, the terminal one brownish black. Antennae with the scape and pedicel yellow; first flagellar segment chiefly yellow, narrowly blackened above, remainder of flagellum black; flagellar segments moderately incised; longest verticils a little less than the segments. Head light brown, grayish pruinose, more heavily so on front, center of vertex and narrow posterior orbits; median line of vertex with a further capillary central brown vitta.

Pronotum gray, restrictedly patterned with pale brown. Mesonotal praescutum with the ground color gray, with four reddish brown stripes, the intermediate pair representing the lateral borders of the broader brownish gray central area; interspaces with conspicuous black setae; posterior sclerites of notum gray, the centers of the lobes vaguely patterned with pale brown. Pleura brownish gray; dorsopleural membrane yellow. Halteres with stem obscure yellow, brighter at base; knob darkened, the apex slightly paler. Legs with the coxae yellowish gray; trochanters yellow; remainder of legs brownish yellow, the outer tarsal segments black; claws toothed. Wings with the ground color of the apical and posterior fields rather strongly infuscated, the central basal and coastal portions more yellowed; stigma pale brown; outer radial field, *m-cu* and distal portion of Cu_1, with axillary border, faintly more darkened; rather conspicuous obliterative areas at cord and beyond stigma, the former almost traversing the wing as a very narrow border to vein M_4; vein 1st*A* and proximal portion of the cell conspicuously whitened; veins brown, more brownish yellow in the brightened fields. Venation: *Rs* about two and one-half times *m-cu*; R_1+_2 entire; *m* subequal to petiole of cell M_1.

Abdomen obscure yellow, the tergites with a narrow median stripe, broadly interrupted at the posterior portions of the segments, and with very restricted sublateral darkenings, best indicated near the bases of tergites three to six, inclusive; lateral tergal borders broadly gray, the caudal margins more narrowly pale; hypopygium large and conspicuous, yellow. Male hypopygium with the ninth tergite transverse, the median blade (*subtergal process* of Dietz) more or less depressed when flattened on a slide; canthi conspicuously toothed or provided with carunculae, the more apical ones larger and more conspicuous; lateral inflexed portion of tergite appearing as a broadly flattened, obtusely rounded

blade. Margin of basistyle with a strong blackened slightly curved point. Outer dististyle an elongate-triangular lobe, narrowed to the very slender apex. Inner dististyle with its outer basal lobe a narrow compressed-flattened blade, not twisted as in *lyrifera*, gradually narrowed to the slightly decurved obtuse tip; main body of style shorter than the lobe, both the beak and lower beak blackened; dorsal crest relatively inconspicuous, separated from the outer basal lobe by a deep incision. Eighth sternite short, narrowed outwardly, the caudal border broadly truncated and fringed with numerous long yellow setae.

Habitat. California.

Holotype. ♂, Kingsbury Grade, Mono Co., May 27, 1939 (Mont Cazier).

The only other described members of the *impudica* group that are allied to the present fly are *T.* (*L*) *diversa* Dietz and *T.* (*L.*) *lyrifera* Dietz both of which have the outer basal lobe of the inner dististyle of the male hypopygium produced somewhat as in this species but with all details of the hypopygium distinct, particularly the tergite and inner dististyle.

Tipula (Lunatipula) mariposa n. sp.

Size medium (wing, male, 15 mm. or more); mesonotal praescutum dark gray, with four poorly indicated brown stripes; wings with an unusually dark brown tinge; male hypopygium with the tergite on either side produced into an unequally bifid fleshy lobe; basistyle with posterior margin blackened and conspicuously bispinous; inner dististyle long and narrow, the posterior margin of the base produced into two blackened spinous points, the outer basal lobe pale and fleshy.

Male. Length about 13.5-15 mm.; wing 15-17 mm; antenna about 3.8-4.2 mm.

Female. Length about 17-18 mm.; wing 15.5-16 mm.

Frontal prolongation of head rich chestnut brown; nasus elongate; palpi black. Antennae (male) of moderate length; scape and pedicel light yellow, first flagellar segment brown, remainder of flagellum black; flagellar segments only moderately incised; longest verticils about equal to the segments. Head dark gray, clear gray on the front and narrow orbits; a vague indication of a still darker median line on vertex.

Pronotum brownish gray. Mesonotal praescutum dark gray, with four poorly indicated brown stripes, the median ground vitta more brownish gray; setae of interspaces black and relatively conspicuous; posterior sclerites of notum gray, the scutal lobes vaguely patterned with darker. Pleura gray, the dorsopleural membrane obscure yellow. Halteres with the stem brown, its base narrowly yellow; knob darkened, its apex restrictedly paler. Legs with the coxae gray; trochanters obscure brownish yellow; femora obscure yellow, the tips narrowly brownish black, the amount subequal on all legs; tibiae and basitarsi obscure brownish yellow, the tips weakly darkened; remainder of tarsi black; claws (male) toothed. Wings with an unusually dark brown tinge, the stigma and costal region still darker; a tiny dark cloud at origin of *Rs;* a very conspicuous whitish obliterative area at and before cord, extending from before stigma in cell R_1, across cell 1*st* M_2 into the basal fourth of cell M_3, insensibly interrupted by narrow seams over the veins; veins dark brown. Venation: *Rs* about two and one-half times the relatively short *m-cu;* R_1+_2 entire.

Abdominal tergites gray, the lateral borders broadly obscure yellow, posterior border of second tergite narrowly gray; dark brown sublateral spots on basal portion of tergites two to six inclusive; setigerous punctures of tergites black, conspicuous; sternites more brownish yellow, the large conspicuous hypopygium likewise of this color. Ovipositor of normal conformation; genital shield black; cerci relatively broad, compressed-flattened, the tips obtusely rounded; hy-

povalvae short and stout, with blunt tips. Male hypopygium with the tergite and basistyle entirely cut off from the sternite by sutures; accessory sclerite of ninth sternite distinct, elongate. Ninth tergite of peculiar conformation, on either side produced into an unequally bifid fleshy lobe, with a further small lateral lobule on caudal margin nearer the side. Ninth sternite with the posterior lobe low and hemispherical, with elongate pale setae, those of ventral portion longer and more crinkly. Basistyle relatively narrow, the posterior margin blackened and conspicuously bispinous; outer spine more roughened, on its upper margin before apex with a small denticle. Outer dististyle a very small pale fleshy lobe at near midlength of dorsal face of inner style. Inner dististyle long and narrow; posterior margin of the base or stem of main body produced into two blackened spinous points, one basal, the other subapical; outer basal lobe pale and fleshy, provided with long conspicuous setae (exact outlines difficult to see because of its lying beneath the spinous lobes of basistyle). Eighth sternite moderately long and sheathing, conspicuously armed with hair-brushes, including an outer or more ventral row, relatively sparse but of long setae, two of the more outer ones on either side enlarged and spinoid; an inner group of setae bend slightly mesad to become decussate with their fellows of the opposite side; besides the above, a semicircular lobe or flap lying dorsad of the lateral portions of the lobe is fringed with abundant elongate crinkly setae, the general effect being that of a double row of bristles.

Habitat. California.

Holotype. ♂, Mormon Bar, Mariposa Co., June 6, 1940 (T. H. G. Aitken). *Allotopotype.* ♀. *Paratopotypes.* Several ♂♂, ♀♀, with the types.

This fly requires comparison only with *Tipula (Lunatipula) yosemite* n. sp. The two species are obviously closely allied, differing from one another in important hypopygial characters, including the tergite, basistyle and inner dististyle.

Tipula (Lunatipula) yosemite n. sp.

Allied to *mariposa;* size small (wing, male, under 14 mm.); wings with a strong brownish tinge, restrictedly patterned with darker brown and with a very conspicuous obliterative band before cord; male hypopygium having the tergite with a narrow V-shaped median notch, the broad lobes slightly armed and corrugated; basistyle with the entire outer portion produced into a sclerotized plate that bears a short marginal beak and other short spinous points; inner dististyle with the anterior lobe massive, the beak very obtuse, blackened; eighth sternite with the caudal border sinuously truncate, conspicuously fringed with long setae.

Male. Length about 12 mm.; wing 13.5 mm.; antenna about 4 mm.

Generally similar to *mariposa*, differing especially in the structure of the male hypopygium. Size relatively small. Antennae with scape and pedicel yellow, first flagellar segment yellow, narrowly infuscated above; remainder of flagellum almost unicolorous brownish black; flagellar segments with the basal enlargement relatively small, the longest verticils nearly equal in length to the segments. Tips of femora and tibiae very narrowly and vaguely darkened; claws toothed. Wings with a strong brownish tinge, restrictedly patterned with pale brown and with the obliterative band at cord unusually conspicuous; the darkened areas include the stigma and very reduced spots at origin of *Rs*, end of *Sc*, and at seams along the cord; the obliterative band extends from vein *R* across cell 1*st* M_2 into cell M_3, less evidently following along vein M_4, virtually to the posterior border.

Male hypopygium with the ninth tergite elongate, the caudal margin with a narrow V-shaped median notch, the broad lateral lobes variously armed and modified, the inner portion adjoining the notch produced into a small darkened lobule, the more extensive outer portion a low flattened lobe that is produced into a slender sclerotized point near its outer angle and with various other

points and setiferous tubercles. Ninth sternite with the appendage appearing as a somewhat triangular cushion, provided with abundant setae, those at the lower portion unusually dense. Basistyle with the entire outer portion produced into a sclerotized plate, the apex of which bears a small marginal beak, with a further small point on face near tip; more basally, the plate is further produced into spinous points. Outer dististyle very tiny, pale, bearing only about six setae. Inner dististyle with its massive anterior portion, including the beak, very blunt and obtuse, the corrugated dorsal crest more or less produced backward; outer basal lobe a small simple entirely pale fleshy lobe, almost as in *maripesa*. Gonapophyses consisting of two flattened paired slender arcuated plates, widest at near midlength, the slender apices each with an acute spine on the lower margin before tip. Eighth sternite with its caudal border sinuously truncated, fringed with conspicuous setae, about three on either side near inner portion of lateral lobe unusually strong and powerful, their tips decussate; numerous smaller and less modified setae fringing the caudal border, lacking on the small U-shaped median notch; on either lateral angle a more nearly detached hemispherical lobe bearing about a score of long setae that are produced directly backward, not decussate.

Habitat. California.

Holotype. ♂, Mormon Bar, Mariposa Co. June 6, 1940 (T. H. G. Aitken). *Paratopotype.* ♂.

The present fly is unquestionably allied to *Tipula* (*Lunatipula*) *mariposa* n. sp., differing conspicuously in most structures of the male hypopygium, particularly the tergite, basistyle and inner dististyle.

Tipula (Lunatipula) aurantionota n. sp.

Allied to *usitata;* size small (wing, male, 13 mm. or less); nasus lacking; thorax fulvous orange, including the usual four praescutal stripes and the scutal lobes; femora brownish yellow, the tips narrowly blackened, preceded by a clearer yellow ring; wings with a weak brownish yellow tinge, restrictedly patterned with dark brown and clear cream-colored areas, the most conspicuous of the latter being the obliterative band before the cord; abdomen yellow, the tergites with a narrow median brown stripe; male hypopygium with the beak of the inner dististyle long-produced and with the tip strongly delimited from the remainder by a ventral notch; phallosome consisting of various spinous points, including a flattened blade that terminates in two such spines, the upper point more slender.

Male. Length about 11-12.5 mm.; wings 11.5-13 mm.; antenna about 3.3-3.4 mm.

Frontal prolongation of head dull brownish yellow, nearly as long as the remainder of head; nasus lacking; palpi with basal segment obscure yellow, second segment light brown, outer segments passing into black. Antennae with scape and pedicel yellow, flagellum black; basal enlargements of flagellar segments feebly indicated; longest verticils a little exceeding the segments. Head light brown, more brownish yellow in front; vertical tubercule low; holotype with a narrow dark median line on vertex, this is not indicated in the paratype.

Entire thorax chiefly fulvous orange, including the usual four praescutal stripes and scutal lobes, the sides of the notum a little more obscured. Halteres with stem yellow, knob infuscated. Legs with coxae and trochanters yellow; femora brownish yellow, the tips narrowly but conspicuously blackened, preceded by a clearer yellow ring; tibiae and basitarsi yellow, the tips darkened; remainder of tarsi black; claws (male) toothed. Wings with a very weak brownish yellow tinge, the prearcular and costal fields clearer yellow; stigma oval, darker brown; clear cream-colored areas occur as a band before cord, crossing cell 1*st* M_2 and almost reaching the posterior wing margin along vein M_4; a small post-

stigmal brightening; a triangular spot at margin in cell 1*st A* near vein 2*nd A*, with a further brightening near outer end of vein 1*st A;* veins brown, more brownish yellow in the brightened fields. Venation: *Rs* long, about two and one-half times *m-cu;* tip of vein R_1+_2 thin but persistent; *m-cu* at or before fork of M_3+_4.

Abdomen yellow, the tergites with a narrow median brown stripe. Male hypopygium having the caudal margin of the ninth tergite with a broad V-shaped notch, with a further narrow emargination at its base, this latter produced cephalad into a deep median dorsal groove; lobes of tergite more heavily thickened, obtusely rounded. Ninth sternite with the appendage small, simple, tipped and fringed with elongate setae. Outer dististyle dark-colored, very broadly triangular in outline, as in the subgroup. Inner dististyle with the beak much prolonged and readily breaking at the point of narrowing; dorsal crest conspicuous, yellow. Phallosome consisting of conspicuous blades and spinous points, including one blade that terminates in two such spines, the upper point more slender. Eighth sternite narrowed outwardly, the posterior border pale, without lateral lobes; on either side of the median line with a brush or pencil of about 15 to 16 long yellow setae, these not decussate.

Habitat. Oregon.

Holotype. ♂, Boyer Station, near McMinnville, Yamhill Co., August 1, 1935 (Coll. R. E. R.); high hemlock association 6; James Macnab No. 111. *Paratopotype.* ♂.

Although it is very different in color from the other species that center around *Tipula* (*Lunatipula*) *usitata* Doane, the present fly undoubtedly falls in this complex of forms. The other species are dark-colored, the praescutum with five dark brown stripes, there being a clearly defined median vitta in addition to the usual four stripes.

Tipula (Lunatipula) snoqualmiensis n. sp.

General coloration of mesonotum light gray, with three poorly defined light brown stripes that are delimited by narrow reddish brown borders, more distinct on the broad median stripe; frontal prolongation of head yellow, sparsely pruinose, nasus short; antennae with scape and pedicel clear light yellow, flagellar segments beyond the second brownish black; head gray; femora and tibiae yellow; claws (male) toothed; wings subhyaline, with a conspicuous dark and light brown pattern, variegated by subhyaline before and beyond the stigma; basal abdominal segments pale yellow, the tergites with indications of a pale brown median stripe; outer abdominal segments more uniformly light brown; male hypopygium with the lateral tergal lobes long-produced, the median notch with a compressed tooth.

Male. Length about 17.5-18 mm.; wing 18-18.5 mm.; antenna about 4.5 mm.

Frontal prolongation of head obscure yellow, sparsely light gray pruinose; nasus short and blunt; palpi with basal two segments yellow, outer segments black. Antennae with scape and pedicel clear light yellow; first and second flagellar segments a trifle more obscure yellow, the remaining segments brownish black, the bases a little more darkened; flagellar segments moderately incised; verticils long and conspicuous, subequal in length to the segments. Head gray, clear light gray on front, darker gray behind, on either side of vertex with conspicuous black bristles.

Pronotum light brown, sparsely pruinose. Mesonotal praescutum with the ground light gray, with three poorly defined light brown stripes that are delimited by narrow reddish brown borders, those of the median stripe very distinct; scutum light gray, each lobe with two reddish brown areas; posterior sclerites of notum gray, parascutella more yellowed; lateral borders of medioter-

gite and the pleurotergite somewhat paler. Pleura pale brownish yellow, with a light gray bloom; dorsopleural membrane clear light yellow. Halteres elongate, stem yellow, knob dark brown, its extreme apex paler. Legs with the coxae and trochanters yellow, sparsely pruinose; femora and tibiae yellow, the tips not or but vaguely darkened; tarsi obscure yellow, passing into brown; claws (male) toothed. Wings with the ground subhyaline, patterned with dark brown, pale brown and whitish subhyaline; prearcular and costal fields clear yellow; the darkest areas include the stigma, anterior cord, *m-cu* and a seam along vein *Cu*, chiefly in Cu_1, not involving cell *M;* paler brown washes beyond cord, including most of the cells, and a small spot at origin of *Rs;* whitish areas include the obliterative band at cord, extending from before the stigma to the posterior border along vein M_4, widely expanded in cell 1*st* M_2; post-stigmal whitening conspicuous, involving the basal half of cell R_2 but barely invading cell R_3; outer ends of cells R_5 and M_1 faintly brightened; veins brown, yellow in the flavous areas. Venation: *Rs* about two and one-half times *m-cu;* R_1+_2 strongly preserved; petiole of cell M_1 a little longer than *m*.

Basal abdominal tergites pale yellow, the more proximal segments with faint indications of a pale brown median stripe; basal sternites light yellow, the outer segments somewhat darker, light brown. Male hypopygium with the suture between the ninth tergite and ninth sternite complete; basistyle broadly suboval in outline, separated from the sternite by a pale ventral suture that is about one-third complete. Ninth tergite large, deeply notched medially, the lateral lobes produced into long, somewhat flattened arms, broad basally, the outer half more narrowed, the tip subacute; outer surface of lobes with coarse black setae, these much shorter and pale yellow at apices of the lobes and likewise becoming very small nearer the midline; at base of notch with a conspicuous compressed median tooth that is directed caudad and slightly dorsad. Ninth sternite with the appendage small but extensive, each further produced at its lower mesal angle into a smaller globular lobule, both lobes with conspicuous setae. Basistyle truncate at apex. Outer dististyle small, placed at base of the inner style; longest setae a little more than one-half the total length of the style. Inner dististyle with both the beak and subapical beak very heavily blackened; dorsal crest undeveloped; outer basal lobe attached to main body of style by a narrow basal union only, appearing as a broadly flattened yellow blade, narrowed at apex into a flattened obtuse beak; surface corrugated longitudinally and provided with abundant pale setae. Phallosome forming a common sclerotized base, with the gonapophyses appearing as divergent paddle-shaped blades near the apex, these arms much longer than the small capitate apical projection that includes the minute aedeagus. Eighth sternite only moderately sheathing, its base telescoped beneath the seventh sternite, its apex terminating about opposite one-fourth the length of the subcylindrical ninth sternite; apex of sternite shallowly notched, the median area with numerous long straight setae; outer portion of the very low oblique lobes with about four more powerful flattened bristles that bend inward, their tips decussate at midline.

Habitat. Washington.

Holotype. ♂, Lake Keechelus, near Snoqualmie Pass, Kittitas Co., June 29, 1924 (A. L. Melander); in Melander Collection. *Paratopotype.* 1 ♂.

This conspicuous fly is readily told from all other regional species of the subgenus *Lunatipula* Edwards that have the tergal lobes of the male hypopygium produced into long horns by its patterned wings and by all details of structure of the male hypopygium. Other regional species having long tergal horns include *Tipula* (*Lunatipula*) *armata* Doane, *T.* (*L.*) *megalabiata* Alexander, *T.* (*L.*) *sternata* Doane and *T.* (*L.*) *tergata* Doane. The most similar of these species is *armata,* but the resemblance is not close, and the two flies are only remotely allied.

LOW TEMPERATURE FUMIGATION

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INTRODUCTION

In the past, fumigation at temperatures much below 60°F. has not been widely advocated to control insect pests in unheated structures. The objections to such a practice have been based on a number of considerations which will be discussed later. The possibility of extending the schedule of treatments to lower temperatures is obviously of great importance in Canada, where the mean monthly temperatures in most parts of the country lie below 60°F. for 8 or 9 months of the year and where there are three or four months when the range is between 40° and 60°F.

With these facts in mind, it would be convenient to define "low temperature fumigation" as a fumigation treatment where the insects are exposed in an environment below 60°F., that is, less than the temperatures likely to be encountered inside heated buildings the year round, or in the outside air during the warmer months of the year.

THEORETICAL CONSIDERATIONS

Volatilization of the fumigants. Some of the most versatile fumigants have high boiling points, far above ordinary room or summer temperatures, yet once they are released in gaseous form they readily diffuse through packages and do not "condense out" at concentrations used in fumigation work. Among these may be mentioned chloropicrin (boiling point, 233.6°F.), carbon tetrachloride, (boiling point 168.8°F.) and ethylene dibromide (boiling point, 268°F.) It is true that these fumigants take a long time to volatilize under normal conditions, and special means have to be adopted to vaporize them, but it is well known that chloropicrin, as one example, is extremely effective over a wide range of conditions and temperatures after it is produced as a gas.

Toxicity to the Insects. The fact that fumigants are effective against insects at lower temperatures has been noted by several workers. Peters and Ganter (1935) working on *Sitophilus granarius* L. with hydrocyanic acid gas noted that results at 32°F. did not differ materially from those at 63°F., and that, if anything, the insects were more sensitive at the lower temperature. Shepard *et al,* (1937) using carbon bisulphide, ethylene dichloride, and chloropicrin found that the amount of fumigant required to produce 50 and 99 per cent kill decreased below 50°F., in tests with *Tribolium confusum* Duv. Moore (1936) working with scale insects in California noted that, in some cases, increased sorption of the gas on the body surface of the insects at lower temperatures led to high mortalities. However, Shepard and Buzicky (1939) found with methyl bromide that although *Tribolium confusum* Duv. reacted similarly at lower temperatures as the other gases investigated by Shepard *et al.* (1937), the granary weevil, *Sitophilus granarius* L., required increasingly higher doses to secure adequate kills at temperatures down to 32°F. In explanation of these phenomena Shepard *et al.* (1937) and Shepard (1939) suggested that at these lower temperatures there is a combined toxic effect of the two agents, gas and cold, working together. It should also be pointed out that sorption of a gas on a surface increases inversely as the temperature and, therefore, at a lower temperature more fumigant would be held by the surface of the insect, and elimination following exposure would be proportionately handicapped. As a general rule, at lower temperatures the rate of the opening and closing of the insect spiracles is reduced (Wigglesworth, 1939) and the respiratory exchange, as measured by carbon dioxide production, is decreased (Uvarov, 1931). These facts immediately suggest that fumigants are able to diffuse through the body wall in

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toxic quantities independently of the respiratory system. Shepard (1939) has cited the work of several investigators who showed that gases can readily penetrate the insect cuticle. Moreover, Wigglesworth (1939) describes the diffusion of carbon dioxide through the integument. It is, therefore, clear from this brief discussion that further information is required to explain the mode of entry and the toxic action of fumigants at different temperatures.

Penetration of Commodities. The increased sorption of the gases by the commodities at the lower temperatures calls for increasing doses to overcome this so that penetration can be effected all the way to the middle, and it is probable that most of the addi ional fumigant required is on account of this.

The retention of the fumigant in the commodity, and consequent increased difficulties in aeration, are important factors to be considered in conjunction with studies on the effect of the chemicals on the goods treated and, under some conditions of storage, on the health of those handling the goods or working in warehouses containing them. For instance chloropicrin, a very effective gas, has been observed to maintain its lachrymatory effect for months following the fumigation of goods subsequently stored in a cool warehouse, and there have been references in the literature to this (see Eichmann, 1943, below).

PRACTICAL USE OF LOW TEMPERATURE FUMIGATION

There are few references in the literature to the successful use of fumigants at low temperatures. In practical tests, under the commercial conditions of fumigation of seed peas to control the pea weevil in warehouses, vaults, and bins in the Palouse district of the State of Washington, Eichmann (1943) reported that chloropicrin was effective in vaults at a dose of 3 pounds per 1,000 cubic feet at temperatures as low as 12°F., but that residual odours of chloropicrin remained in the peas for several days and caused eye irritation and nausea among the workmen. Methyl bromide and hydrocyanic acid gas produced good kills as low as 58°F. and 35°F. respectively, but the latter gas gave some survival near the top of the material at 40°F. In none of these tests was fan circulation employed, so it is difficult to appraise the results, having in mind the fact that fans are usually recommended for vault fumigations.

In fact, in view of the wide range of conditions and equipment encountered, very few results obtained by Eichmann are strictly comparable, although of great interest because of their indication of effective fumigations during the winter at low temperatures.

Instructions issued by the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine (1943), for treatments under the Japanese beetle quarantine, permit the use of methyl bromide against potted plants and plants with bare roots for vault fumigation with circulating fans at temperatures as low as 38°F. The schedule of treatments calls for increasingly higher doses and longer exposure periods corresponding to decreases in temperature.

ATMOSPHERIC FUMIGATION OF OVERWINTERING CORN BORERS

In connection with the atmospheric fumigation of imported broom corn in railroad cars, some experiments were carried out in Montreal during February and March, 1944, to estimate the increase in dose of methyl bromide required for control at lower temperatures. Methyl bromide is a colourless, practically odourless gas, boiling from a colourless liquid at 40.1°F. This gas is 3.3 times as heavy as air.

Methods. In these experiments a small, steel, fumigation vault having a capacity of thirty cubic feet was employed. It was cooled by allowing city water to flow through the heating coils. The temperature of this water was almost constant at 39°F. Specially constructed bales of Argentine broom corn were used

weighing from 80 to 108 pounds each and of dimensions of 18 inches diameter and 36 inches in length, which would fit conveniently into the vault. These bales were stored outside for at least 24 hours prior to treatment to allow them to cool to the outside temperatures prevailing. After each treatment the bales were throughly aerated before being used again, the elimination of methyl bromide being tested with the Halide leak detector.

The test insects employed were overwintering larvae of the corn borer, *Pyrausta nubilalis* Hbn., collected in Ontario in 1943, and stored in a cool dry room at a temperature of 40°F. The borers were placed singly in size 0 or 00 gelatine capsules and inserted into specially adapted broom handles pierced with holes one inch apart. In previous work these capsules had been found satisfactory for testing the depth of penetration of gases into bales of broom corn (Monro and Delisle, 1943).

One stick containing thirty borers was placed in the bale cooling outside six hours before the overnight fumigation. The borers were thus able to conform approximately to the temperature prevailing in the different parts of the bale. A thermometer was kept in the bale awaiting the next treatment so that an accurate reading could be made.

When the bales containing the experimental sticks were placed inside the vault, a flat pan was placed on top to prevent the liquid methyl bromide from the measuring apparatus from flowing into the bale itself. A recording thermometer kept a record of the vault temperature during the treatment. After closing the door, the dose of methyl bromide in cubic centimetres for the vault, corresponding to a dose in pounds per thousand cubic feet of space, was accurately measured off in the special "280 cc." methyl bromide applicator. In order to simulate the conditions under which the work would actually be done, no fan circulation was employed to disperse the gas during the treatment. The period of time in all the tests was 16 hours, corresponding to an "overnight" treatment. At the completion of the test the vault was "air washed" by drawing two or three successive vacuums of one inch of absolute pressure. In all these tests the vault temperatures lay between 40° and 50°F., and it will be noted from Table I that, if the temperatures of the bales be regarded as the "temperature during exposure", the maximum is the only one that can rightly be taken for application to practical work. For purposes of comparison, however, the mean temperature is also shown in Table I.

On examination two days after treatment, after being kept at room temperature, a high percentage of the larvae were found in a moribund condition. Those showing any sign of life were then incubated at 80°F. and 68-70% relative humidity. The final mortality count was then taken one week after fumigation. Further incubation revealed that those then enumerated as survivors subsequently developed at least as far as the pupal stage and the majority emerged as adults.

Discussion of Results. The data is set out in the table to show the increasing dose of methyl bromide required to produce one hundred per cent kill as the bale temperatures were lowered. The detailed results of each treatment, showing the position in the stick of the surviving insects and thus their depth within the bale, are not given here. However, survivors were invariably found towards the middle of the sticks, a fact which might be expected if diffusion of the gas followed a gradiant of concentration from the outside to the middle of the bale.

It will be noted that in some cases the bale temperatures were very low and with the subsequent increase during treatment, in a large number of cases, were still well below the boiling point of methyl bromide. However, even at the lowest temperatures, a complete kill of the test insects could be obtained by applying a sufficient dose.

In appraising these results of low temperature fumigation, two considera-

tions must be borne in mind: (1) Owing to the setup of the experimental vault and measuring apparatus, the methyl bromide was discharged into the vault almost entirely as a gas, except perhaps in the case of the higher doses when the amount of fumigant varied between 40 and 60 cubic centimetres; (2) The dose of fumigant was applied directly above the individual bale being tested. These are two important factors demonstrating the limits of the experimental environment in relation to the application of the results obtained to commercial practice.

TABLE 1
TOXICITY OF METHYL BROMIDE TO LARVAE OF *PYRAUSTA NUBILALIS* PLACED IN BALES OF BROOM CORN
Exposure Period: 16 hours

Date 1944	BALE TEMPERATURE, °F. (a) Range	(b) Mean	CH_3 Br. lbs. Per 1000 cu. ft.	Bale, lbs. Weight	Mortality Percentage
30-31/3	39-50	45	.75	67	23
29-30/3	34-46	40	.75	108	63
28-29/3	34-47	40	.75	85	63
31/3-1/4	38-45	42	.75	104	83
24-25/3	40-46	43	1.0	99	100
27-28/3	36-46	41	1.0	82	87
23-24/3	35-46	40	1.0	83	100
17-18/3	45-48	47	2.0	108	100
21-22/3	28-46	37	1.5	67	100
15-16/2	29-42	36	2.0	85	100
22-23/3	30-42	36	2.0	104	100
15-16/3	35-42	38	3.0	108	100
31/1-1/2	25-35	30	4.0	108	100
17-18/2	17-35	26	2.0	108	83
14-15/2	22-36	29	3.0	83	97
10-11/2	14-27	21	4.0	108	100
4-5/2	14-33	24	4.0	99	100
10-11/3	15-34	25	4.0	85	100
3-4/2	12-34	23	5.0	83	100
2-3/2	25-32	29	5.0	108	100
7-8/2	18-32	25	6.0	108	100
1-2/2	12-34	23	6.0	83	100
11-12/2	6-27	17	3.0	104	80
16-17/2	2-32	17	5.0	99	100
9-10/2	6-28	17	6.0	99	100
8-9/2	2-26	14	7.0	83	100
8-9/2	6-28	17	CONTROL	82	3

GENERAL DISCUSSION AND CONCLUSIONS

The experiments described in this paper tend to bear out the contention that fumigations can be carried out at fairly low temperatures. In this work the fumigant was almost certainly completely volatilized during the entire period of treatment and the importance of obtaining this condition cannot be overemphasized, especially in treatments where fan circulation is not available.

Therefore, the crux of all low temperature fumigations lie in the success of obtaining complete volatilization of the chemical and proper distribution in the structure. If this is effected, insects can be killed if suitable modifications in dosage are made to overcome both sorption by the commodity and variations in the resistance of the insects.

SUMMARY

A brief review is given of the problem of conducting "low temperature fumigations" below 60°F., to control insect pests, and the literature is discussed.

Experiments carried out with larvae of the corn borer, *Pyrausta nubilalis* Hbn., indicate that methyl bromide can penetrate cold bales of broom corn at

temperatures as low as 26°F., and probably lower, in toxic quantities, by the employment of increasing doses at lower temperatures. No fan was employed to circulate the fumigant in these experiments, but problems of distribution under practical space-fumigation conditions could not be properly duplicated as the test vault contained only one bale, and the fumigant was discharged directly above it.

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APHIDS ON CANADA WILD RICE

An interesting collection of aphids was made on September 15, 1945, when the species *Rhopalosiphum prunifoliae* Fitch was taken in very large numbers from wild rice, *Zizania aquatica* L., at Jemseg, N.B.

The aphids were so abundant that every randomly collected stalk was coated with the insects. Considerable foliage injury and head drop was noted, a condition which was undoubtedly due largely to the injury caused by the aphids.

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